



BUILDING COMMISSIONING

for better public buildings

CASE STUDY REPORT

City of Nampa Gets Some First-hand Experience

Executive Summary



The Nampa City hall is a 23,000 square foot brick office building. Built in 1982, it houses 40 City of Nampa staff members. Over the years the building had drifted away from its original design intent as a result of inconsistent maintenance practices and a series of remodels. The building's HVAC distribution system was designed for architectural (partial height) partitions between offices that have been replaced by hard walls, resulting in serious airflow and temperature problems. The hot and cold spots within the building led several staff members to keep portable heaters in their offices, while others used fans to improve air circulation.

In August of 2001 the Idaho Energy Division, on behalf of the City of Nampa, contracted PECCI of Portland, Ore. to *retrocommission* the City Hall facility as part of a larger remodel project, with the goals of improving occupant comfort, improving maintenance procedures and reducing energy use.

Project at a Glance

Facility	Nampa City Hall
Location	Nampa, ID
Facility Type	Office
Size	23,000 square feet
Utilities	Idaho Power and Intermountain Gas
Project Description	Retrocommissioning, in conjunction with a larger remodel
Energy Savings	\$16,790 per year ¹
Estimated Non-Energy Benefits	\$19,920 ²
Commissioning Cost	\$19,317 ³

¹Annual energy savings based on cost of electricity of \$0.0494/kWh and natural gas of \$0.75/therm.

²Cost reduction or avoidance.

³Commissioning provides fee only.

The retrocommissioning process included a review of building documentation, interviews with occupants and facility managers, and field investigations including monitoring and analysis of building systems, development of a findings list with supporting energy savings calculations, and observation and monitoring of implemented improvements.

The commissioning provider's work yielded 13 findings, five recommended improvements and \$16,790 in potential yearly energy savings. The findings and recommended measures were divided into three categories, to assist the City in deciding which measures to implement:

- *Operation and maintenance*: repairs with paybacks estimated less than two years.
- *Capital improvements*: repairs with longer energy saving payback estimates.
- *Soft improvement opportunities*: repairs with savings estimates based on experience rather than modeling or calculations.

The City chose to implement most of the findings and recommendations, and incorporated them into a larger remodel project conducted in 2002. City Hall is much improved as a result. Staff members no longer keep heaters or fans in their offices and there are far fewer temperature complaints. In addition, facility staff now has an O&M manual and new guidelines for working with HVAC contractors. Cost savings and energy conservation potential are also impressive. Annual utility cost savings are estimated at \$16,790, or 50% of the City's 2000 utility bill. At an implementation cost of \$22,025, the simple payback for the project is 2.5 years.

Introduction

Nampa City Hall was built in 1982. This 23,210 square foot, single story brick office building houses 40 full-time staff members, including the Mayor and the City Council chambers. Over the years the building had drifted away from its original design intent as a result of inconsistent maintenance practices and a series of remodels. The building's HVAC systems were designed for architectural (partial height) partitions between offices, which had been replaced by hard walls, resulting in serious airflow and temperature problems. Several staff members kept portable heaters in their offices while others used fans to improve air circulation. As Nampa Building Official Dennis Davis explains, "We had all kinds of complaints."

The decision to use a retrocommissioning process to resolve City Hall's temperature and maintenance issues came naturally to the Mayor and City Council. The City of Nampa is a leader in energy conservation, participates in the Rebuild Idaho program, and was the first city in Idaho to adopt the NorthWest Energy Code. Elected officials and building staff were already familiar with retrocommissioning, and the Idaho Energy Division paid for the

retrocommissioning study through the Northwest Energy Efficiency Alliance's Commissioning in Public Buildings Program.

In retrocommissioning City Hall, the Mayor and staff had three goals: upgrade outdated systems, provide a more comfortable work environment and improve energy conservation. An important step in achieving these goals was to improve O&M practices. As Mike Purcell of the Energy Division explains, "One of the bigger goals was to get the building tuned up so that it worked better from a comfort standpoint, but also to ensure that the improved comfort level would persist over time. In order to do that the City needed to improve the consistency of the facility's operations and maintenance. This meant providing guidelines for whoever performs the work – whether it's contracted out to a third party or conducted by City of Nampa staff."

The City Hall facility includes an HVAC system with one air handler and several terminal reheat boxes controlled by thermostats throughout the building. The facility does not have a direct digital control system, and both the chiller and boiler are turned on and off manually. Perimeter zones are heated with hot water baseboard radiation units, cooling is provided by a cooling coil in the air handler, and a 60-ton chiller with two compressors supplies cold water. Routine O&M is performed by in-house personnel. Their work includes adjusting thermostats and replacing light bulbs. The City hires outside contractors when the onsite staff is unavailable or unable to solve more complex problems.

Retrocommissioning began in August 2001 and was provided by PECI of Portland, Ore. and Sawtooth Technical Services, a local commissioning provider. The project team included PECI, Sawtooth, City Hall staff and the Energy Division. A mechanical engineering firm was hired later in the project to implement the improvements.

Retrocommissioning

WHAT IS IT?

Retrocommissioning, also known as "existing building commissioning," is a systematic process for optimizing the operation of existing systems in existing buildings. Retrocommissioning can solve issues of high energy and maintenance costs, occupant complaints, indoor environmental quality, and shorter than expected equipment lives. Unlike traditional engineering energy studies, retrocommissioning focuses on identifying low cost operational and maintenance improvements rather than capital improvement measures. The following features are hallmarks of retrocommissioning:

- Occurs in an existing building (post-occupancy)
- Focuses on operational issues
- Looks at building systems, not just pieces of equipment
- Recommends improvements to a building's operation to help the building function optimally according to the current needs of occupants

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WHEN DOES IT OCCUR?

The retrocommissioning process is performed on existing buildings, often where commissioning was not included during original construction. Equipment testing is timed to coincide with the most appropriate ambient conditions. A typical retrocommissioning process can be completed in two to 12 months, depending on the project's objectives and scope.

WHAT DOES IT DO?

The *retrocommissioning* process goes beyond analysis of individual pieces of equipment to examine how equipment and systems operate interactively. It can provide training for O&M staff as well as updating and enhancing the building documentation. Retrocommissioning can focus on solving an array of problems, from comfort to excessive energy costs. Most retrocommissioning studies focus on energy-intensive systems including heating and cooling (HVAC), lighting, and related controls. The retrocommissioning scope may also include identifying and recommending potential retrofit opportunities.



Operation and Maintenance (O&M) is a familiar acronym for building owners. Retrocommissioning typically focuses on the “O”: operations. Even the best maintained equipment is often operated inefficiently - consider an HVAC system that is left running when the building is unoccupied. By examining the building's intellectual property, for example control strategies and scheduling, retrocommissioning finds operational changes that can yield significant energy savings, even in well-maintained buildings.

Sometimes, retrocommissioning seeks to bring a building back to the original design intent. However in many cases, the building's original design no longer meets the needs of the current occupants. Where significant changes have occurred, retrocommissioning may seek to optimize performance for the current occupant needs rather than restoring the building to its original design.

In some situations, deferred maintenance issues are so severe that the building owner needs assistance prioritizing problems. In these cases, retrocommissioning also helps the owner identify and eliminate maintenance issues that prevent the building from operating optimally.

Planning

The first step in the *retrocommissioning* process is planning. The owner puts together a project team that may include building staff, an in-house project manager and a commissioning provider. The owner and commissioning provider work together to set objectives for the process.

The Process

The *retrocommissioning* process at Nampa City Hall was conducted over a two-year period. First the provider evaluated the facility and recommended improvements to the owner. Then, the selected measures were incorporated into a larger remodel.

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Hiring the provider. The City of Nampa relied on the Energy Division to recommend a retrocommissioning provider. Energy Division staff are knowledgeable about commissioning and used the Building Commissioning Association website (www.bcx.org) as a way to identify providers in their area.

Setting objectives. The goals of the process resulted from both immediate comfort concerns and a longstanding interest in energy and resource conservation. In the short term, the City wanted to provide a more comfortable working environment for its employees. They also wanted to put measures in place to ensure efficient operations into the future.

Developing a plan. The commissioning provider began by collecting and evaluating building documentation. City Hall staff provided 30 months of utility billing data, building control sequences and blueprints. Since the retrocommissioning project was part of a larger remodel, the commissioning provider did not recreate the building's original design intent, but instead set goals for how the systems should operate to maintain a comfortable, energy efficient work environment according to the City's current needs.

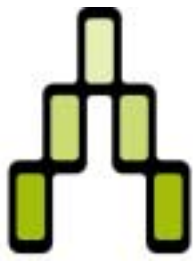
Assessment

The second step in the *retrocommissioning* process is assessment. The provider obtains or recreates missing documentation and conducts a site visit. He or she performs diagnostic monitoring and functional tests and analyzes the results. Finally, a master list of findings and recommendations is created.

Site Assessment. There was no need to recreate building documentation for the Nampa City Hall because the staff supplied it. The commissioning provider spent several days on site conducting a comfort survey, interviewing staff, analyzing ductwork, inspecting controls and observing equipment operation.

Diagnostic Monitoring and Functional Tests. The commissioning provider used portable dataloggers to monitor the HVAC system and build an electric load profile of City Hall. As part

As the commissioning provider says in the Final Report, "The design review was considered a success, as many valuable comments were provided and the designers responded in writing to each comment."



BETTERBRICKS

of this process the provider used a digital manometer to measure airflow in ducts and diffusers and paper disk recorders to gauge space temperatures. The provider also measured interior light levels and metered the supply and return fans to evaluate economizer operation.

Develop Findings List. The site assessment revealed 13 findings and five recommended improvements. The commissioning provider divided these into three categories to help the City evaluate their implementation options. *Operation and maintenance* improvements have energy saving paybacks of two years or less – the retrocommissioning process identified seven O&M findings. *Capital improvements* have paybacks of more than two years – the process identified six such measures. *Soft improvements* have variable savings estimates based on the commissioning provider's experience, rather than energy models or engineering calculations. The process revealed five soft improvements.

Implementation

The third step in the *retrocommissioning* process is implementation. Findings are prioritized and repaired, equipment is re-tested and tuned and energy savings calculations are revised. At Nampa City Hall, the commissioning provider identified payback times and estimated costs for each finding, and the City then selected which measures to implement. In this case, almost all the recommended measures were implemented. City Hall staff performed many of the fixes and the more complicated improvements were incorporated into the larger remodel project. The commissioning provider helped the City develop a scope of work for these items, which was integrated into the Request for Proposals and became part of the remodeling contractor's scope of work. Of the 13 findings and five recommended improvements, the City implemented 16 items or almost 90% of the possible fixes.

Handoff

Findings identified during the retrocommissioning process (including repairs and capital improvements) were completed in November 2002. The commissioning provider returned for a post-implementation inspection to verify that repairs were correct and newly installed equipment was functioning properly. This included a visual inspection and the use of data loggers to monitor equipment operation. The commissioning provider discovered several measures not performing as expected and made recommendations, which the HVAC contractor carried out. Work on the project concluded in February 2002 and most significant issues were resolved as of March 2003.

At handoff, the retrocommissioning provider gave the City a Final Report detailing all findings and their resolution. In their effort to improve O&M procedures, the HVAC contractor hired for the remodel project was required to produce a thorough O&M manual for the building systems. The commissioning provider reviewed the manual

and suggested improvements. The City also wanted to contract with a single company to provide all contracted HVAC service. As part of this effort, the commissioning provider contributed to the scope of work for an extended maintenance service agreement.

According to Dennis Davis, “The retrocommissioning process was a positive experience for the City. For the people who maintain the building it was wonderful from an educational standpoint, and provided them a greater understanding of the relationship between the building and its systems. But really it served as an education for us all.”

Commissioning Provider Dave Beck concurs, “Both sides were willing to help, learn and contribute. It was a good atmosphere all around.”

Findings, Costs and Benefits

The commissioning provider made 13 O&M findings and suggested five additional improvements, each of which contributed to the City’s goals of improving the work environment, reducing energy use and improving O&M. The City implemented 11 of the findings and all improvements, utilizing either the HVAC contractor employed in the remodel project or the facility’s own staff.

Sample O&M findings and recommendations include:

Reduce airflow to the City Engineer’s office. Before its conversion to offices, this workspace housed the facility’s computer server. The high airflow requirements were never adjusted, resulting in wide temperature swings and an uncomfortable work environment. The HVAC contractor removed diffusers and sealed the duct connections at the main duct.

Delamp selected workspaces. Four offices had higher light levels than recommended, which not only wastes energy but can cause headaches and eyestrain. Facility staff removed or disconnected selected ballasts and lamps.

Repair main air handler’s time clock to provide appropriate scheduling. When the system was originally installed the “optimal start function” had not been perfected, did not function properly and was subsequently disabled by the facility staff. As a result the air handler was not scheduled to shut down during unoccupied hours. The contractor installed a new digital controller to schedule air handler operation and helped staff program the system to shut down during nights, weekends and holidays.

Incorporate occupancy-based control to City Council’s chambers. The Council chamber can accommodate large crowds but is only at full capacity a few hours per week. However the airflow remained constant, regardless of occupancy. The contractor installed a new variable air volume control box in the chamber, with an on/off switch, and tuned the control settings to reduce the airflow during unoccupied periods.

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Repair economizer to allow for free cooling. The main airhandler’s outside, mixed, and return air damper controls were originally designed to maximize the use of “free” economizer cooling when the outside air temperature was below a certain threshold. This important component was not functioning when the commissioning provider evaluated the facility. The contractor repaired and tuned the economizer control settings to allow for optimal use of “free cooling.”

Table 1 below summarizes the benefits of each of the implemented measures.

Measure	Benefit		
	Comfort	Energy Savings	O&M
O&M Improvements			
Reduce air to city engineer’s space	U	U	
Delamp selected offices	U	U	U
Replace main air handler’s timeclock	U	U	U
Install VAV control box in Chambers	U	U	U
Repair economizer	U	U	U
Upgrade chiller controls		U	U
Upgrade boiler controls		U	U
Capital Improvements			
Install VFD on supply and return fans	U	U	U
Upgrade flex duct	U	U	
Replace personal heaters with radiant panels	U	U	
Air balance building	U	U	U
“Soft” Improvements			
Efficiency test & optimize boiler		U	U
Change filters and repair manometer			U
Repair unloader on air compressor			U
Implement utility tracking program		U	U
Expand O&M training & procedures	U	U	U

Table 1. Retrocommissioning Findings and Benefits

Since the retrocommissioning measures were incorporated into a larger remodel project, actual cost data is not available. However, the commissioning provider estimates the cost of the implemented items at \$22,025. With a yearly energy savings estimate of \$8,073, the simple payback for the project is 2.7 years. Table 2 below summarizes the estimated implementation cost and energy savings for the implemented measures, including a 20% weighted average allowing for measure interaction. It is interesting to note that when lower-cost O&M measures are implemented together with more capital-intensive retrofit measures they help reduce the payback period for the total project.

Table 2. Retrocommissioning Cost and Benefit Summary

Measure Type	Implementation Cost	Annual Cost Savings	Simple Payback
O&M	\$8,225	\$10,228	1.7 years
Capital Improvements	\$13,800	\$6,562	2.1 years
“Soft” Improvements	Unknown	Unknown	Unknown
All Measures	\$22,025	\$8,073	13 years

Conclusion

City Hall is much improved as a result of the retrocommissioning process. Occupants no longer keep heaters or fans in their offices and there are far fewer temperature complaints. In addition, facility staff has an O&M manual and new guidelines for working with HVAC contractors. Says Dennis Davis, “The building is more comfortable. We’ve gained a greater awareness of the conditioning systems and we’re doing regular maintenance rather than spot work as problems arise. In the long run we’ll end up saving money because we’ll be able to troubleshoot problems before they happen.”

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The Alliance is a non-profit group of electric utilities, state governments, public interest groups and efficiency industry representatives working to make affordable, energy-efficient products and services available in the market place.

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